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(54) **ACIDIC POST-SPUTTER WASH FOR MAGNETIC RECORDING MEDIA**

(71) Applicant: **WD Media, LLC**, San Jose, CA (US)

(72) Inventors: **Hooi In Tan**, Singapore (SG); **Chin Hoe Teoh**, Penang (MY)

(73) Assignee: **WD Media, LLC**, San Jose, CA (US)

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CPC ***G11B 5/851*** (2013.01); ***C23C 14/5873*** (2013.01); ***G11B 5/667*** (2013.01)

(58) **Field of Classification Search**
CPC G11B 5/66; G11B 5/667; G11B 5/851
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See application file for complete search history.

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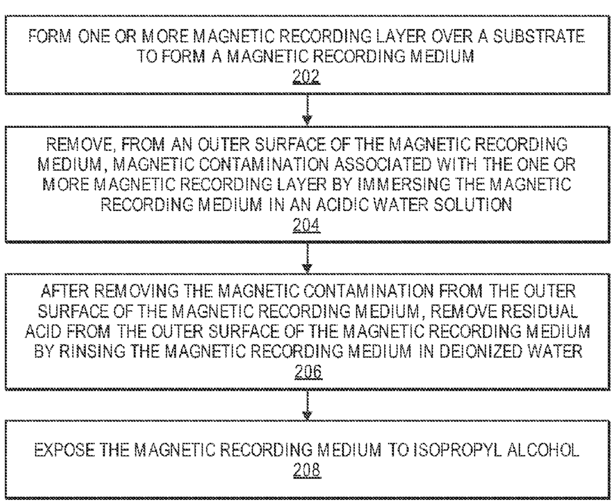
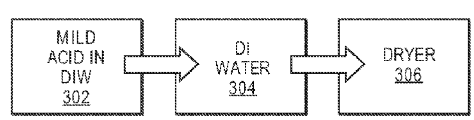
(57) **ABSTRACT**

A recording medium having an outer surface relatively free of magnetic particulates is achievable by, after forming a magnetic recording layer with which magnetic contamination is associated, removing magnetic contamination from the medium by immersing the medium in an acidic water solution. For example, a post-sputter wash process utilizing a mildly acidic water solution having a pH less than around 5 may remove cobalt particle contaminants from the surface of the medium. The water solution may be acidized by introducing into deionized water a pre-diluted strong acid such as nitric acid or a weak acid such as carbonic acid.

20 Claims, 3 Drawing Sheets





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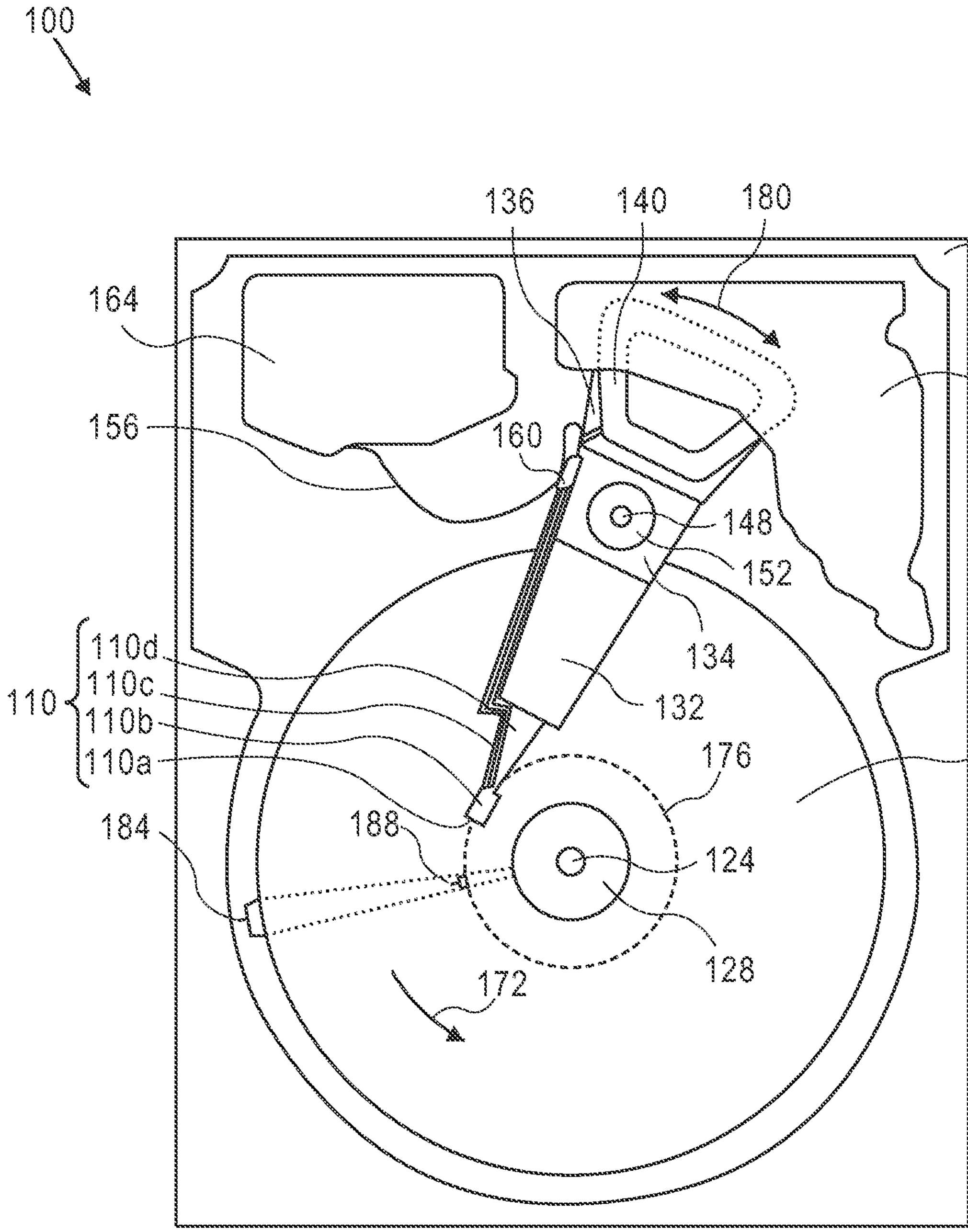
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120
176
184
188
124
128
172

FIG. 1

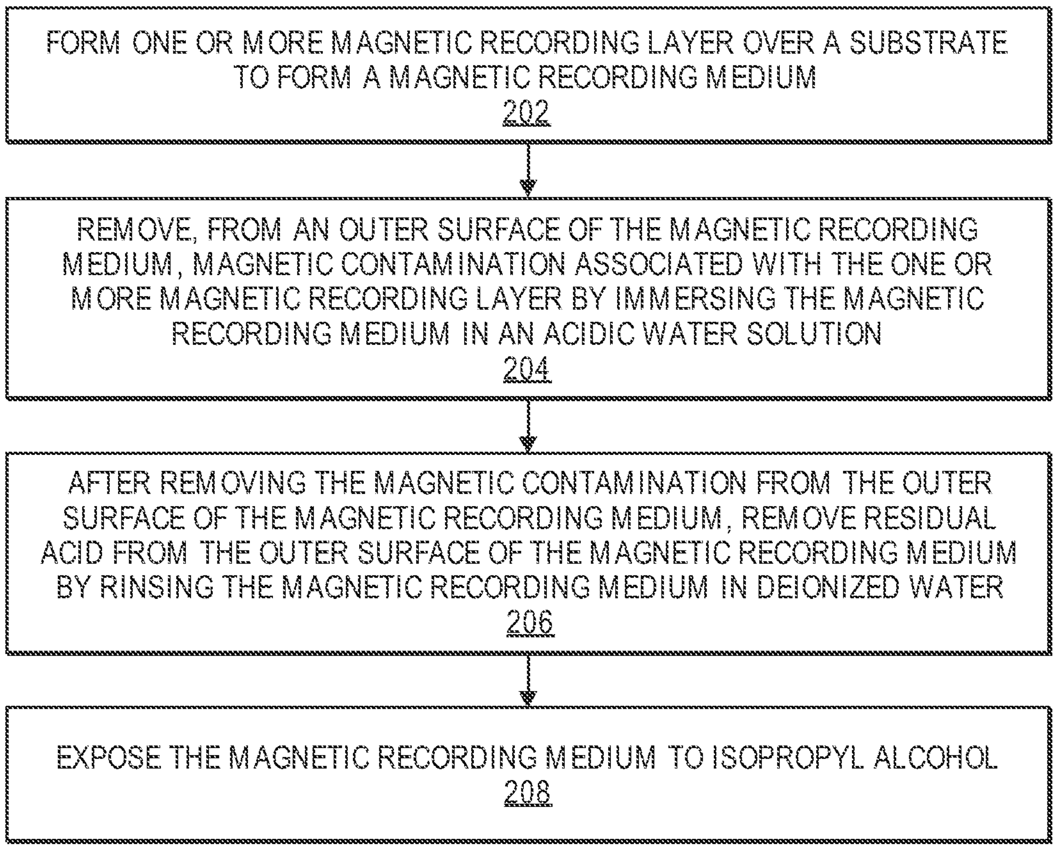
FORM ONE OR MORE MAGNETIC RECORDING LAYER OVER A SUBSTRATE TO FORM A MAGNETIC RECORDING MEDIUM
202
REMOVE, FROM AN OUTER SURFACE OF THE MAGNETIC RECORDING MEDIUM, MAGNETIC CONTAMINATION ASSOCIATED WITH THE ONE OR MORE MAGNETIC RECORDING LAYER BY IMMERSING THE MAGNETIC RECORDING MEDIUM IN AN ACIDIC WATER SOLUTION
204
AFTER REMOVING THE MAGNETIC CONTAMINATION FROM THE OUTER SURFACE OF THE MAGNETIC RECORDING MEDIUM, REMOVE RESIDUAL ACID FROM THE OUTER SURFACE OF THE MAGNETIC RECORDING MEDIUM BY RINSING THE MAGNETIC RECORDING MEDIUM IN DEIONIZED WATER
206
EXPOSE THE MAGNETIC RECORDING MEDIUM TO ISOPROPYL ALCOHOL
208

FIG. 2

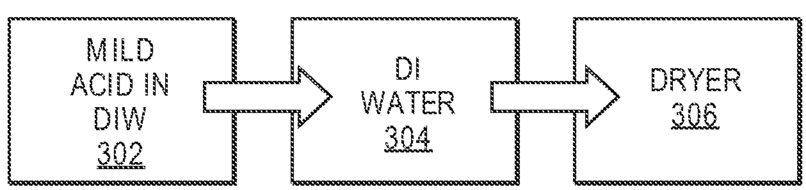
MILD ACID IN DIW
302
DI WATER
304
DRYER
306

FIG. 3

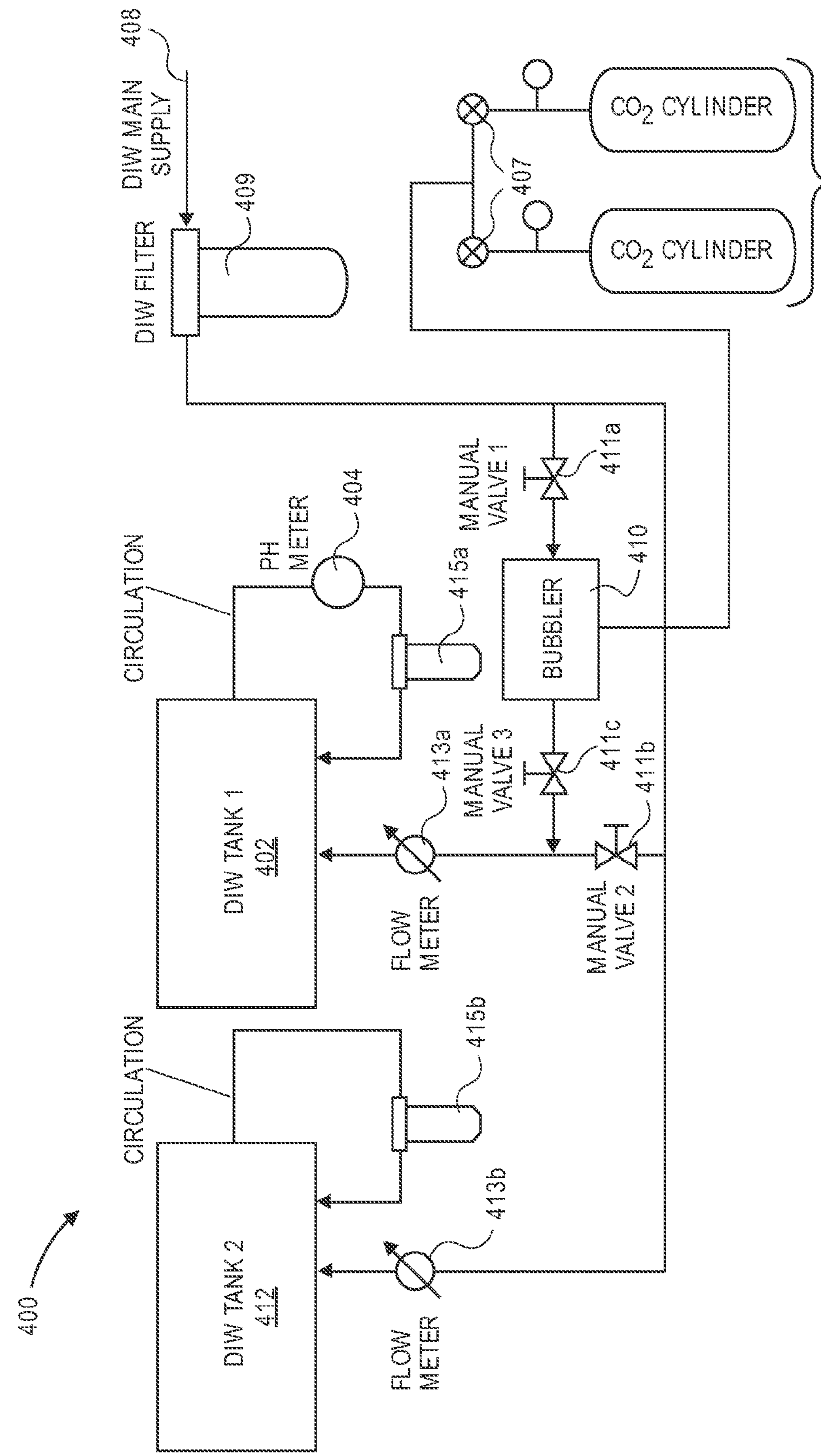
400
408
DIW MAIN SUPPLY
DIW FILTER
409
CO_2 CYLINDER
CO_2 CYLINDER
407
406
CIRCULATION
PH METER
404
415a
MANUAL VALVE 1
411a
BUBBLER
410
DIW TANK 1
402
MANUAL VALVE 3
411c
411b
413a
FLOW METER
MANUAL VALVE 2
CIRCULATION
415b
DIW TANK 2
412
413b
FLOW METER

FIG. 4

ACIDIC POST-SPUTTER WASH FOR MAGNETIC RECORDING MEDIA

BACKGROUND

A hard-disk drive (HDD) is a non-volatile storage device that is housed in a protective enclosure and stores digitally encoded data on one or more circular disks having magnetic surfaces. When an HDD is in operation, each magnetic-recording disk is rapidly rotated by a spindle system. Data is read from and written to a magnetic-recording disk using a read-write head that is positioned over a specific location of a disk by an actuator. A read-write head uses a magnetic field to read data from and write data to the surface of a magnetic-recording disk. Write heads make use of the electricity flowing through a coil, which produces a magnetic field. Electrical pulses are sent to the write head, with different patterns of positive and negative currents. The current in the coil of the write head induces a magnetic field across the gap between the head and the magnetic disk, which in turn magnetizes a small area on the recording medium.

Increasing areal density (a measure of the quantity of information bits that can be stored on a given area of disk surface) is one of the ever-present goals of hard disk drive design evolution. As areal density increases, the read-write head generally needs to fly closer and closer to the disk surface. Likewise, as the read-write head flies closer to the disk surface, unwanted head-disk interactions (e.g., a "crash") are more likely to take place. Furthermore, because modern HDDs fly the head so very close to the disk surface, the presence of surface contaminants on either the head and/or the disk can increase the likelihood of head-disk crashes.

Any approaches described in this section are approaches that could be pursued, but not necessarily approaches that have been previously conceived or pursued. Therefore, unless otherwise indicated, it should not be assumed that any of the approaches described in this section qualify as prior art merely by virtue of their inclusion in this section.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments are illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings and in which like reference numerals refer to similar elements and in which:

FIG. **1** is a plan view illustrating a hard disk drive, according to an embodiment;

FIG. **2** is a flow diagram illustrating a method of manufacturing a magnetic recording medium, according to an embodiment;

FIG. **3** is a diagram illustrating a post-sputter wash (PSW) process, according to an embodiment; and

FIG. **4** is a diagram illustrating an example setup for a PSW process, according to an embodiment.

DETAILED DESCRIPTION

Approaches to a post-magnetic layer deposition wash process for a magnetic recording medium are described. In the following description, for the purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the embodiments described herein. It will be apparent, however, that the embodiments described herein may be practiced without these specific details. In other instances, well-known structures and devices are shown in block diagram form in order to avoid unnecessarily obscuring the embodiments described herein.

Physical Description of Illustrative Operating Environments

Embodiments may be used in the context of a magnetic recording medium in a hard-disk drive (HDD) data storage device. Thus, in accordance with an embodiment, a plan view illustrating an HDD **100** is shown in FIG. **1** to illustrate an examplary operating environment.

FIG. **1** illustrates the functional arrangement of components of the HDD **100** including a slider **110***b* that includes a magnetic-reading/recording head **110***a*. Collectively, slider **110***b* and head **110***a* may be referred to as a head slider. The HDD **100** includes at least one head gimbal assembly (HGA) **110** including the head slider, a lead suspension **110***c* attached to the head slider typically via a flexure, and a load beam **110***d* attached to the lead suspension **110***c*. The HDD **100** also includes at least one magnetic-recording medium **120** rotatably mounted on a spindle **124** and a drive motor (not visible) attached to the spindle **124** for rotating the medium **120**. The head **110***a* includes a write element and a read element for respectively writing and reading information stored on the medium **120** of the HDD **100**. The medium **120** or a plurality of disk media may be affixed to the spindle **124** with a disk clamp **128**.

The HDD **100** further includes an arm **132** attached to the HGA **110**, a carriage **134**, a voice-coil motor (VCM) that includes an armature **136** including a voice coil **140** attached to the carriage **134** and a stator **144** including a voice-coil magnet (not visible). The armature **136** of the VCM is attached to the carriage **134** and is configured to move the arm **132** and the HGA **110**, to access portions of the medium **120**, being mounted on a pivot-shaft **148** with an interposed pivot-bearing assembly **152**. In the case of an HDD having multiple disks, the carriage **134** is called an "E-block," or comb, because the carriage is arranged to carry a ganged array of arms that gives it the appearance of a comb.

An assembly comprising a head gimbal assembly (e.g., HGA **110**) including a flexure to which the head slider is coupled, an actuator arm (e.g., arm **132**) and/or load beam to which the flexure is coupled, and an actuator (e.g., the VCM) to which the actuator arm is coupled, may be collectively referred to as a head stack assembly (HSA). An HSA may, however, include more or fewer components than those described. For example, an HSA may refer to an assembly that further includes electrical interconnection components. Generally, an HSA is the assembly configured to move the head slider to access portions of the medium **120** for read and write operations.

With further reference to FIG. **1**, electrical signals (e.g., current to the voice coil **140** of the VCM) comprising a write signal to and a read signal from the head **110***a*, are provided by a flexible interconnect cable **156** ("flex cable"). Interconnection between the flex cable **156** and the head **110***a* may be provided by an arm-electronics (AE) module **160**, which may have an on-board pre-amplifier for the read signal, as well as other read-channel and write-channel electronic components. The AE **160** may be attached to the carriage **134** as shown. The flex cable **156** is coupled to an electrical-connector block **164**, which provides electrical communication through electrical feedthroughs provided by an HDD housing **168**. The HDD housing **168**, also referred to as a base, in conjunction with an HDD cover provides a sealed, protective enclosure for the information storage components of the HDD **100**.

Other electronic components, including a disk controller and servo electronics including a digital-signal processor (DSP), provide electrical signals to the drive motor, the voice coil **140** of the VCM and the head **110***a* of the HGA **110**. The electrical signal provided to the drive motor enables the drive motor to spin providing a torque to the spindle **124** which is in turn transmitted to the medium **120** that is affixed to the spindle **124**. As a result, the medium **120** spins in a direction **172**. The spinning medium **120** creates a cushion of air that acts as an air-bearing on which the air-bearing surface (ABS) of the slider **110***b* rides so that the slider **110***b* flies above the surface of the medium **120** without making contact with a thin magnetic-recording layer in which information is recorded.

The electrical signal provided to the voice coil **140** of the VCM enables the head **110***a* of the HGA **110** to access a track **176** on which information is recorded. Thus, the armature **136** of the VCM swings through an arc **180**, which enables the head **110***a* of the HGA **110** to access various tracks on the medium **120**. Information is stored on the medium **120** in a plurality of radially nested tracks arranged in sectors on the medium **120**, such as sector **184**. Correspondingly, each track is composed of a plurality of sectored track portions (or "track sector"), for example, sectored track portion **188**. Each sectored track portion **188** may be composed of recorded data and a header containing a servo-burst-signal pattern, for example, an ABCD-servo-burst-signal pattern, which is information that identifies the track **176**, and error correction code information. In accessing the track **176**, the read element of the head **110***a* of the HGA **110** reads the servo-burst-signal pattern which provides a position-error-signal (PES) to the servo electronics, which controls the electrical signal provided to the voice coil **140** of the VCM, enabling the head **110***a* to follow the track **176**. Upon finding the track **176** and identifying a particular sectored track portion **188**, the head **110***a* either reads data from the track **176** or writes data to the track **176** depending on instructions received by the disk controller from an external agent, for example, a microprocessor of a computer system.

Introduction

As discussed, the presence of surface contaminants on a magnetic recording medium (e.g., a magnetic recording disk) can increase the likelihood of head-disk crashes. For example, cobalt (Co) particles diffusing up from the magnetic recording layer(s) may ultimately become magnetic contaminants on the outer surface of the recording disk. Therefore, the magnetic recording disk surface is typically cleaned to minimize surface contaminants. However, it has been found that, due to the electronegativity of nitrogen associated with a nitrogenated carbon overcoat on the outer surface of the media, even with surface cleaning dissolved metallic ions (e.g., Co^{2+}) are attracted to and can adsorb onto the media surface during a post sputter wash (PSW) process. Cobalt contamination levels on media have been linked to lube pick-up and touch down power changes in hard disks drives and, therefore, minimizing magnetic contamination levels on media can improve hard disk drive reliability.

For particle reduction purposes, magnetic recording disks may be post-sputter washed (PSW) in deionized water and then dried shortly after exiting the sputter system. However, it has been found that the PSW process could lead to higher cobalt contamination if there is a prolonged waiting time between sputter and PSW processes (this delay is referred to as "WIP time"). Controlling WIP times is not always practical or even possible in production due to equipment availability issues, for example.

Furthermore, the cobalt adsorption mechanism may be more prominent when the sputtered magnetic disks are exposed to the production environment, whereby organic contaminants such as phthalates, chelating with Co^{2+} in PSW water tanks, lead to higher cobalt adsorption. Storing disks in a fully enclosed chamber between sputter and PSW has been shown to eliminate the WIP time dependence of cobalt contamination. However, this is not practical for all production lines, and it would be an expensive modification to the conveyors used to transport the disks from sputter to PSW, or a significant cost of additional labor to move disks into enclosures after sputter and to remove the disks from enclosures immediately before PSW.

Method of Manufacturing Magnetic Recording Media

FIG. **2** is a flow diagram illustrating a method of manufacturing a magnetic recording medium, according to an embodiment.

At block **202**, one or more magnetic recording layer is formed over a substrate, to form a magnetic recording medium. For example, one or more layers of magnetic material containing cobalt are deposited over a substrate. Depending on the type of medium being fabricated, numerous and various underlayers, exchange break layers, overcoats, and the like, which are not the focus of embodiments described herein, may also be formed over the substrate before and/or after forming the one or more magnetic recording layer.

Reference herein to a "layer" is not intended to be thereby limited to a single layer, rather each "layer" referenced may actually comprise multiple layers, or a "stack" of thin film layers. Further, the terms "fabricated" and "formed" may include any of a number of thin film processes, such as chemical and/or physical deposition processes (of which sputtering is commonly used in hard disk media production), which "grow" grains of poly-crystalline thin films, for example, as well as may promote crystalline epitaxial growth, and the like. Therefore, use of these terms and related terms do not limit to any particular process, unless otherwise indicated.

According to one embodiment, the act of forming one or more magnetic layer at block **202** includes performing a sputter deposition process to form the magnetic layer(s). According to a related embodiment, the act of forming one or more magnetic layer at block **202** includes performing a sputter deposition process of a cobalt-based magnetic material to form the magnetic layer(s).

At block **204**, magnetic contamination associated with the one or more magnetic recording layer is removed from the outer surface of the magnetic recording medium by immersing the medium in an acidic water solution. Recall that cobalt particles (or other magnetic material particles) diffusing up from the magnetic recording layer(s) may ultimately become magnetic contaminants on the outer surface of the recording disk, and that even when a post-sputter wash (PSW) process is utilized, dissolved metallic ions (e.g., Co^{2+}) can adsorb onto media surface during the PSW process. According to an embodiment, the act of removing magnetic contaminants includes removing cobalt particles from the surface of the medium.

By reducing the pH of the water in the PSW water tank, cobalt adsorption can be reduced. Such reduction of cobalt adsorption on the surface of the magnetic recording medium may be based at least in part by operation of the standard electro potential associated with cobalt. Furthermore, the acidity in the PSW water tanks promotes metallic contaminants to dissolve.

According to an embodiment, the act of removing the magnetic contamination by immersing the magnetic recording medium in an acidic water solution at block **204** includes immersing the medium in a water solution having a pH less than around 5.0, an acidic level found to be effective for the purpose of removing such magnetic contaminants. Viable candidates for modifying the pH of the deionized water used in the PSW tank for the foregoing purpose include use of a diluted "strong" acid such as nitric acid (HNO_3) and a "weak" acid such as carbonic acid (H_2CO_3). Thus, according to an embodiment, prior to immersing the magnetic recording medium at block **204**, a mild acid is introduced into a deionized water source, where the mild acid comprises around a 2% or lower pre-diluted nitric acid.

Similarly, according to another embodiment, prior to immersing the magnetic recording medium at block **204**, a mild acid is introduced into a deionized water source, where the mild acid comprises a carbonic acid. Note that when water is exposed to air, a low concentration of CO_2 naturally dissolves in the water. Hence, deionized water is usually slightly acidic, having a weak carbonic acid component. This leads to a pH ranging between 5.5 and 6.5 depending on temperature, agitation and time of exposure. However, the use of an acidic water solution at block **204** is not intended to fall within such a pH range that occurs naturally when water is exposed to the CO_2 in air. A higher carbonic acid content corresponding to lower pH can be achieved via other means, which are described in more detail in reference to FIG. **4**.

Magnetic recording media production typically further comprises forming an overcoat over the magnetic recording layer(s), at least in part to protect the layers of metals and possibly other materials lying under the overcoat layer. For a non-limiting example, a nitrogenated carbon overcoat may be formed over the magnetic recording layer(s) and any subsequent layers (if any). According to an embodiment, it is this outer overcoat surface from which the magnetic contamination is removed at block **204**. Thus, a magnetic recording medium subjected to the foregoing wash process could and may exhibit an outer surface, e.g., the overcoat surface, that is substantially free of magnetic particulates. For example, the outer surface of a magnetic recording medium may have less than around 28 pg/cm^2 of Co, e.g., just after fabrication and early in the HDD lifecycle. For one non-limiting but practical example, a mean cobalt level of around 23 pg/cm^2, having a standard deviation of around 2 pg/cm^2, was achieved for a set of over 250 magnetic recording disks by using a mildly acidic deionized water post-sputter wash as described herein. Cobalt levels are known to be higher for magnetic recording disks with thinner carbon overcoats and higher nitrogen levels. Thus, it was investigated and found that the cobalt levels are systematically reduced after acidic PSW, for all carbon thicknesses and nitrogen levels within the normal range of production.

Furthermore and according to an embodiment, additional magnetic contamination may be removed from the magnetic recording medium by immersing the medium in a second acidic water solution, after immersing the medium in the acidic water solution at block **204**.

With the foregoing process, the deposition of layers can be performed using a variety of deposition sub-processes, for non-limiting examples, physical vapor deposition (PVD), sputter deposition and ion beam deposition, and chemical vapor deposition (CVD) including plasma enhanced chemical vapor deposition (PECVD), low pressure chemical vapor deposition (LPCVD) and atomic layer chemical vapor deposition (ALCVD). Furthermore, other suitable deposition techniques known in the art may also be used.

FIG. **3** is a diagram illustrating a post-sputter wash (PSW) process, according to an embodiment. Blocks **302-306** are generally referred to herein as a series of "tanks". A mildly acidic DIW tank **302** facilitates immersing the magnetic recording medium in a mildly acidic water solution (e.g., block **204** of FIG. **2**), such as a deionized water-diluted nitric acid solution or a deionized water-carbonic acid solution.

Returning to FIG. **2**, at optional block **206**, after removing magnetic contamination from the surface of the magnetic recording medium at block **204**, residual acid is removed from the magnetic recording medium by rinsing the medium in deionized water ("DI water"). Thus, block **206** generally corresponds to DI water tank **304** of FIG. **3**, which refers to a second wash, or rinse, of the magnetic recording medium in DI water. This rinse is performed in un-augmented deionized water, i.e., one in which nitric or carbonic acids are not directly or intentionally introduced.

With further reference to FIG. **2**, at optional block **208** the magnetic recording medium is exposed to isopropyl alcohol ("IPA"). Such exposure to IPA may be implemented, for example, as an IPA immersion of the medium (possible including an ultrasonic mechanism to facilitate particle removal) and then to an IPA vapor tank to expose the medium to IPA vapor. The primary purpose for exposing the magnetic recording medium to IPA is to remove residual water/moisture on the medium from the DI water tank **304** (FIG. **3**). Another approach to exposing the magnetic recording medium to IPA at optional block **208** may be, for example, immersing the medium in a solution of DI water, N_2 and IPA. In either example scenario, block **208** generally corresponds to dryer tank **306** of FIG. **3**.

FIG. **4** is a diagram illustrating an example setup for a post-sputter wash (PSW) process, according to an embodiment. The PSW process setup exemplified in FIG. **4** may be used to perform part of the method of manufacturing described in reference to FIG. **2**. However, FIG. **4** refers solely to the PSW process and does not include tooling for the deposition processes, such as magnetic recording layer formation, overcoat formation, and the like. Furthermore, FIG. **4** depicts but one non-limiting approach to a PSW process setup, i.e., an example. Thus, a PSW process setup for practicing embodiments described herein may vary from implementation to implementation and may, therefore, vary from the setup depicted in FIG. **4**.

PSW setup **400** comprises a first deionized water (DIW) tank **402** and a second deionized water (DIW) tank **412**. PSW setup **400** further comprises a DIW main supply line **408** which flows DIW through a DIW filter **409**. From the DIW filter **409**, filtered DIW flows through a flow meter **413***b* corresponding to the DIW tank **412** (e.g., DIW water tank **304** of FIG. **3**) and hence into the DIW tank **412**. A filter **415***b* is also associated with a circulation flow for DIW tank **412**.

Furthermore, from the DIW filter **409**, filtered DIW flows to and/or through a valve **411***b* and onward through a flow meter **413***a* corresponding to the DIW tank **402** (e.g., mildly acidic DIW tank **302** of FIG. **3**) and hence into the DIW tank **402**. The DIW flowing through the valve **411***b* may be mixed with mildly acidic DIW flowing through the valve **411***c*, described in more detail herein.

This particular example setup illustrated in FIG. **4** is applicable to a PSW process that utilizes a carbonic acid wash. One non-limiting, practical approach to introducing carbonic acid into the DIW tank **402** is by using resistivity equipment **410** (e.g., a "bubbler") for injecting CO_2 gas into DI water. In the example PSW setup **400**, the resistivity equipment **410** is fed CO_2 gas by one or more CO_2 cylinder **406**, controlled by a valve controller **407**. Thus, CO_2 flows to the resistivity equipment **410** while DI water flows from the DIW filter **409** through the valve **411***a* and through the resistivity equipment **410**, where the DI water is "carbonic acidized". The mild carbonic acid impregnated water can then flow on through valve **411***c* (possibly mix with DIW flowing through valve **411***b*) and onward through the flow meter **413***a* and into DIW tank **402**. A pH meter **404** and a filter **415***a* are also associated with a circulation flow for DIW tank **402**. Process knobs such as CO_2 gas pressure adjustment, and DIW flow rate through the eFlow, can be used to maintain a certain desired pH for the DI water in DIW tank **402**, which can be monitored by the pH meter **404**.

Extensions and Alternatives

In the foregoing description, embodiments of the invention have been described with reference to numerous specific details that may vary from implementation to implementation. Therefore, various modifications and changes may be made thereto without departing from the broader spirit and scope of the embodiments. Thus, the sole and exclusive indicator of what is the invention, and is intended by the applicants to be the invention, is the set of claims that issue from this application, in the specific form in which such claims issue, including any subsequent correction. Any definitions expressly set forth herein for terms contained in such claims shall govern the meaning of such terms as used in the claims. Hence, no limitation, element, property, feature, advantage or attribute that is not expressly recited in a claim should limit the scope of such claim in any way. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense.

In addition, in this description certain process steps may be set forth in a particular order, and alphabetic and alphanumeric labels may be used to identify certain steps. Unless specifically stated in the description, embodiments are not necessarily limited to any particular order of carrying out such steps. In particular, the labels are used merely for convenient identification of steps, and are not intended to specify or require a particular order of carrying out such steps.

What is claimed is:

1. A method of manufacturing a magnetic recording medium, the method comprising:

forming one or more magnetic recording layer over a substrate to form a magnetic recording medium; and

removing, from an outer surface of said magnetic recording medium, magnetic contamination associated with said one or more magnetic recording layer by immersing said magnetic recording medium in an acidic water solution.

2. The method of claim **1**, wherein said forming includes performing a sputter deposition process, and wherein said removing includes removing cobalt particle contaminants from said outer surface of said magnetic recording medium.

3. The method of claim **1**, wherein said immersing includes immersing said magnetic recording medium in a water solution having a pH less than around 5.

4. The method of claim **1**, further comprising:

prior to said immersing, introducing a mild acid into a deionized water source, wherein said mild acid comprises around a 2% or lower pre-diluted nitric acid.

5. The method of claim **1**, further comprising:

prior to said immersing, introducing a mild acid into a deionized water source, wherein said mild acid comprises a carbonic acid.

6. The method of claim **1**, further comprising:

after removing said magnetic contamination from said outer surface of said magnetic recording medium, removing residual acid from said outer surface of said magnetic recording medium by rinsing said magnetic recording medium in deionized water.

7. The method of claim **6**, further comprising:

exposing said magnetic recording medium to isopropyl alcohol.

8. The method of claim **1**, wherein said immersing comprises immersing in a first acidic water solution, the method further comprising:

further removing magnetic contamination from said outer surface of said magnetic recording medium by immersing said magnetic recording medium in a second acidic water solution after immersing in said first acidic water solution.

9. A magnetic recording medium prepared by a process comprising:

forming one or more magnetic recording layer over a substrate;

forming an overcoat over said one or more magnetic recording layer, thereby forming an unfinished magnetic recording medium; and

removing, from an outer surface of said unfinished magnetic recording medium, magnetic contamination associated with said one or more magnetic recording layer by immersing said magnetic recording medium in an acidic water solution, thereby forming a finished magnetic recording medium;

wherein said outer surface of said finished magnetic recording medium is substantially free of magnetic particulates on said overcoat.

10. The magnetic recording medium of claim **9**, wherein said forming one or more magnetic recording layer comprises performing a sputter deposition process, and wherein said removing includes removing cobalt particle contaminants from said outer surface of said magnetic recording medium.

11. The magnetic recording medium of claim **9**, wherein said immersing includes immersing said magnetic recording medium in a water solution having a pH less than around 5.

12. The magnetic recording medium of claim **9**, wherein said acidic water solution comprises a solution of around 2% or lower pre-diluted nitric acid with deionized water.

13. The magnetic recording medium of claim **9**, wherein said acidic water solution comprises a solution of carbonic acid with deionized water.

14. The magnetic recording medium of claim **9**, the preparation process further comprising:

exposing said finished magnetic recording medium to isopropyl alcohol.

15. A data storage device comprising:

a magnetic recording medium rotatably mounted on a spindle, said magnetic recording medium prepared by a process comprising:

forming one or more magnetic recording layer over a substrate;

forming an overcoat over said one or more magnetic recording layer, thereby forming an unfinished magnetic recording medium; and

removing, from an outer surface of said unfinished magnetic recording medium, magnetic contamination associated with said one or more magnetic recording layer by immersing said magnetic recording medium in an acidic water solution, thereby forming a finished magnetic recording medium;

wherein said outer surface of said finished magnetic recording medium is substantially free of magnetic particulates on said overcoat;

a read-write head slider configured to read from and to write to said magnetic recording medium; and

a voice coil actuator configured to move said head slider to access portions of said magnetic recording medium.

16. The data storage device of claim **15**, wherein said forming one or more magnetic recording layer comprises performing a sputter deposition process, and wherein said removing includes removing cobalt particle contaminants from said outer surface of said magnetic recording medium.

17. The data storage device of claim **15**, wherein said immersing includes immersing said magnetic recording medium in a water solution having a pH less than around 5.

18. The data storage device of claim **15**, wherein said acidic water solution comprises a solution of around 2% or lower pre-diluted nitric acid with deionized water.

19. The data storage device of claim **15**, wherein said acidic water solution comprises a solution of carbonic acid with deionized water.

20. The data storage device of claim **15**, the preparation process further comprising:

after removing said magnetic contamination from said outer surface of said magnetic recording medium, removing residual acid from said outer surface of said magnetic recording medium by rinsing said magnetic recording medium in deionized water; and

exposing said magnetic recording medium to isopropyl alcohol.

* * * * *